古人骨の受傷痕と原因武器に関する研究

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１５３７０１００

平成１５年度～平成１７年度科学研究費補助金（基盤研究(Ｂ)）研究成果報告書

平成１８年　５月

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＜はしがき＞

本報告書は、日本学術振興会科学研究費補助金（基盤研究（B）、課題番号：15370100）の援助により実施したグループ研究の成果を報告するものである。本研究の課題名、目的、概要、研究組織、交付決定額、ならびに研究発表等は以下の通りである。

研究課題名：　古人骨の受傷痕と原因武器に関する研究

研究目的：

考古学の遺跡ではときに、死亡前後に刺創、切創、割創などの受傷痕（殺傷痕）が刻まれた人骨が出土する。本研究では、鳥取県の青谷上寺地遺跡、奈良県の四分遺跡、兵庫県の新方遺跡など弥生時代の遺跡で発見された受傷人骨資料を司法人類学的な観点で精査することにより、そうした受傷痕を形態学的に比較分析する。さらに古代の武器類のレプリカを用いて動物の新鮮骨に骨損傷を起こす。実際に古人骨で見られる受傷痕と動物骨に実験的に生じしめた骨損傷を照合することで、古人骨の受傷痕から原因武器を特定する方策を模索するとともに死因を推測する道を探る。もって、「倭国の大乱」頃の争いごとや戦闘行為の実態を実証的に解明せんとする。

研究の概要：

３年間の実施期間に、研究集会、ワークショップ、シンポジウムなどで学際的な相互討論を重ね、弥生時代の武器のレプリカでニホンザルやブタの骨に骨損傷を生じさせる実験を積み重ね、さらには古人骨や司法解剖人骨での損傷例を比較研究することにより、予想外の武器で思わぬ骨損傷ができることが判明したり、古代武器の予想外の使用法を示唆することができたりするなど、いくつかの新知見が得られた。また研究分担者や研究協力者が各々の研究テーマで独自の研究活動を進めることにより、骨損傷の形態学的分析法を開発し、原因武器の推定法などを示すことができた。今後、さらに深化させるべき共同研究を推進する道が拓けたと言えよう。

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研究成果による工業所有権の出願・取得状況

該当なし

Introduction to Symposium :

"Sword injuries on ancient human skeletal remains from archaeological sites in Japan: Several case studies and the weapons to be identified as the causative agents"

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In recent several years, we have come across the human skeletal remains unearthed at archaeological sites, in which perimortem injuries caused by various types of weapons are printed on the bones, and thus they are considered to be of the victims who were supposedly killed at the time of some conflicts or war-like affairs. Such probable violent death cases have been not a few found thus far particularly from the Yayoi-period sites in the northern Kyushu, Chugoku and Kinki districts, and from the medieval sites in Kamakura-city areas. Especially, a heap of human skeletal remains with injuries have been unearthed at the Aoya-Kimijichi Yayoi site in Tottori Prefecture and at several Kamakura-period sites in Kanagawa Prefecture.

Osteoarchaeologically it is very interesting that actually quite many specimens suggesting such cases were found from the Yayoi-period site. The reason is that it is commonly accepted that in the latter part of the period, especially in the west part of Japan, there was the so-called *Wakoku-no-tairan* situations in which conflicts or wars were rather usually happened among district-clan groups. At the same time, there have been found many kinds of weapons, which are made of bronze, iron, wood or stone. The implications are that social conflicts or war-like affairs became increased in the period concomitantly with innovation in special kinds of weapons. In this context, it is very important to identify actually used weapons for each bone injury. After that, we will be able to get insight into how people fought with others in the Yayoi period, what kind of weapons were practically used or ritual, and how weapons and fighting styles were becoming changed.

At the present symposium, first, three papers have been presented on describing in detail the morphology of injuries on the human skeletal remains recently found at the Aoya-Kamijichi site, on those at the Shibu Yayoi site in Nara Prefecture, and on those at two medieval sites in Kamakura-city (Inoue and Matsumoto's paper, Oyabu and Katayama's paper, and Hirata and other's paper). Secondly, two archaeologists have given papers on the weapons discovered from the Yayoi-period site, in connection with injury patterns on those human skeletons (Fukasawa's paper and Matsugi's paper). Thirdly, the first report on human skeletal remains unearthed from the Ohtomo Yayoi site in the northern Kyushu has been presented (Nakahashi's paper), and finally we have joined to discuss, being focused on the causative relation of bone wounds and the weapons supposedly used in the Yayoi period and on the scale and state of war affairs in ancient Japan.

Undoubtedly the Aoya-Kamijichi skeletal material is thus far the best sample to look into war-like incidents in the *Wakoku-no-tairan* situations in the Yayoi period. Its investigators have come to conclude it as remains caused by a kind of massacre case. The discovery has been close-upped very much in an archaeology-related field, and in public as well, because those skeletons should be an excellent example to suggest that drastic increase in murder cases happened in the Yayoi period, and to make more clear about the weapons practically used at that time.

Anyway the present symposium has been very fruitful to present sword-injured human skeletons due to war-like incidents from both the Yayoi and Kamakura periods from the viewpoint of skeletal biology, and to discuss about weapon types to cause such injuries on skeletons and about how the people struggled using those weapons in ancient Japan from the viewpoint of archaeology.

Injuries found in human skeletal remains of the Yayoi period from Aoya-Kamijichi site

Takao Inoué and Michika Matsumoto

Department of Anatomy, Faculty of Medicine, Tottori University, Yonago 683-8503, Japan

Injuries found in human skeletal remains of the Yayoi period from Aoya-Kamijichi site

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The Aoya-Kamijichi site, located in the eastern part of Tottori Prefecture, was found in the bypass road construction of No. 9 national route in 1998. Since various kinds of well-preserved remains were found, it is called Yayoi museum. The site was located near lagoon and remains were isolated from air, so woods and netting that cannot be remained in ordinary condition were admirably preserved.

Approximately 6000 pieces of human bones (enough to make at least approximately 100 human body skeletons) were excavated from the groove dug along the eastern edge of the site. These bones are estimated to belong in the latter part of Yayoi period, i.e. approximately 1800 years ago, from the shape of accompanying bowls. Most of the bones were found without ordered arrangement. Among these bones we found 110 pieces of bones with marks of injuries (Table 1). From the analysis of the bones, they contained at least 11 cadavers (adult male; 4, adult female; 4, juvenile; 3).

There were several types of bone injuries. In the skull, a large fusiform-shaped perforation and small ellipsoidal perforation were noted. Fusiform-shaped perforations through the calvaria were found

Table 1. Number of bone injury

bone	right	axial	left	subtotal
Skull(male)		4		
skull (female)		1		
mandible		1		
Cervical vertebra		3		
Thoracic vertebra		10		
Lumbar vertebra		1		
sternum		2		
rib	18		18	36
scapula	1		5	6
clavicle	2		4	6
humerus	5		8	13
radius	0		2	2
ulna	2		3	5
coxa	3		4	7
femur	2		4	6
tibia	1		4	5
fibula	0		1	1
1st metatarsus			1	1
			total	110

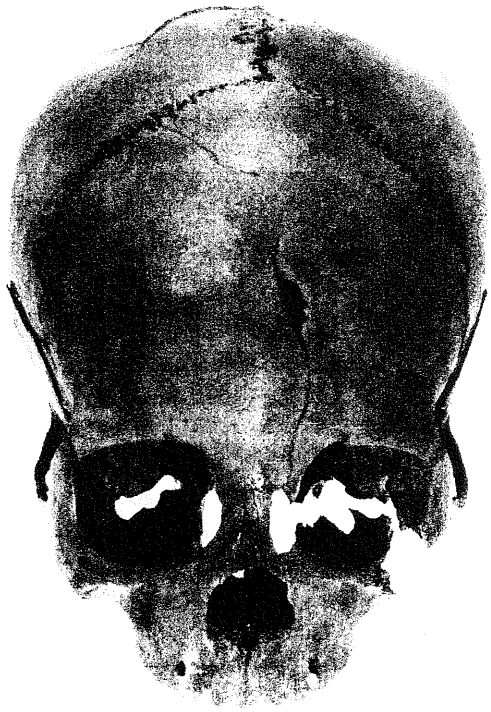


Figure 1. Fusiform perforation in the frontal bone.

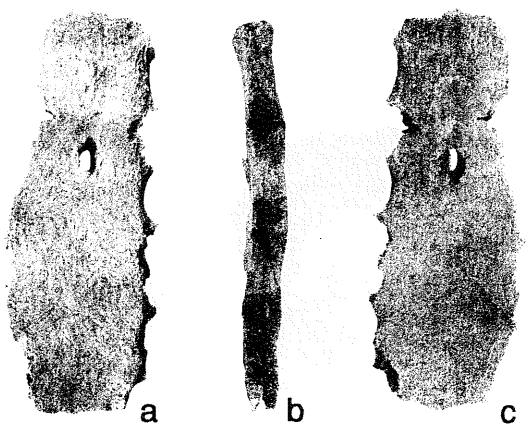


Figure 2. Small ellipsoidal perforation in the sternum. a: anterior view. b: lateral view. c: posterior view.

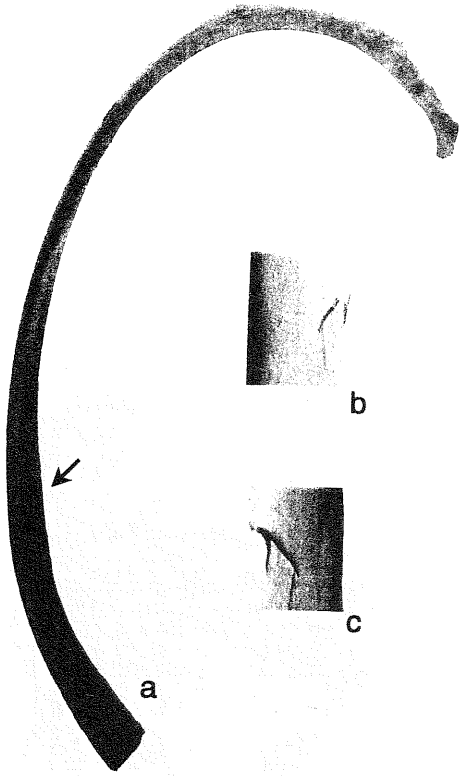
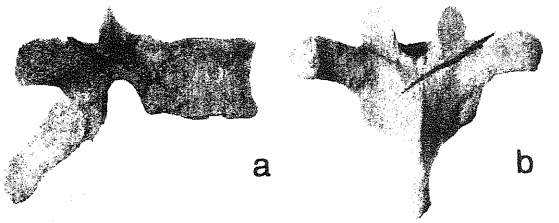


Figure 3. Clear-cut wound of the rib. a: whole inferior view of the left rib showing the location of the injury (arrow). b: outer closer view of the injury. c: inner closer view of the injury.



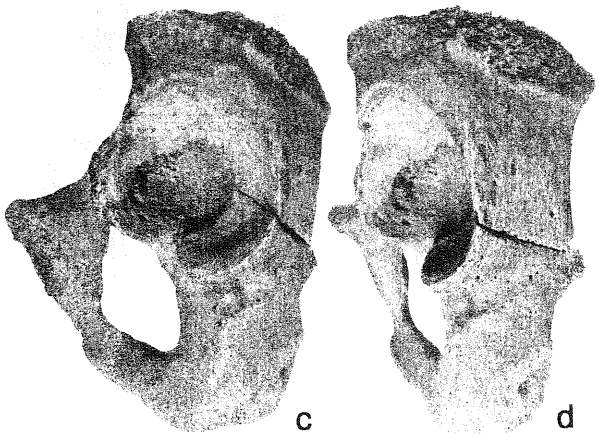


Figure 4 (left). Deep clear-cut injury of the vertebra(a, b) and hip bone (c, d). a: lateral view. b: posterior view. c: lateral view. d: posterior view.

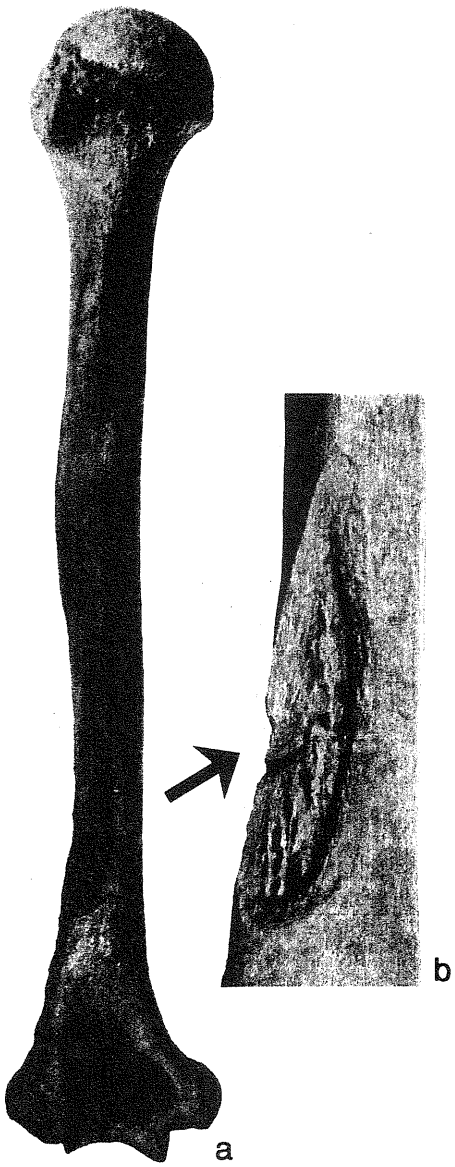


Figure 5 (upper). Right humerus showing the trace of insertion by a spearhead. a: whole view of the humerus with a split fracture. b: closer view of the bone injury. Arrow indicates the direction of the insertion of the weapon.

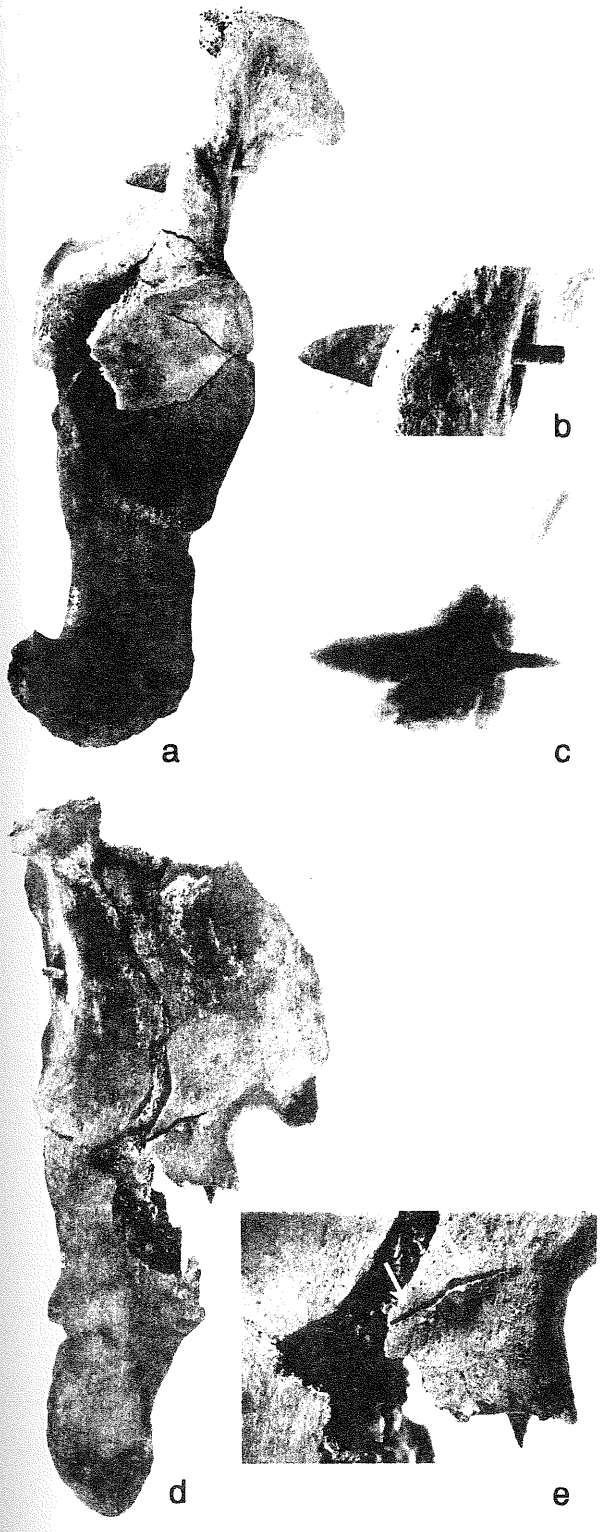


Figure 6. Left hip bone with a spearhead. a: anterior view. b: closer view of the spearhead. c: X-ray photograph of the spearhead. d: posterior view. e: closer view of a clear-cut wound (arrows).

in two skulls. The size of the perforation was 4 x 19 mm in the frontal bone and 5 x 16 mm in the parietal bone. From the margin of the cut edge, split fracture lines were extended. These perforations were probably pieced by metallic swords (Figure 1). A small ellipsoidal perforation was observed in the frontal bone, which was probably pierced by a sharp spear. The size was 2.5 x 5 mm in the frontal bone. This kind of perforation is also observed in the sternum and a split fracture was observed on the cortex of the inner surface (Figure 2).

The most common bone injuries were clear-cut wound, which was probably occurred by a thin blade. The edge is quite sharp and the injuries deeply extended into the spongy substance of the bones. This type was found in the ribs (Figure 3), vertebrae (Figure 4a, 4b), hip bones (Figure 4c, 4d) and so on. In the rib, the cut wound was seen in both upper and lower edge. Occasionally, three cut wounds were seen in one rib,

It is difficult to identify the kind of weapons from the cut wounds alone. Although the sword is a common weapon which produce a clear-cut wound, it is probable more thinner blades can be used in this site. Judging from the shape of the cut wound together with its location of the bone, sickle-

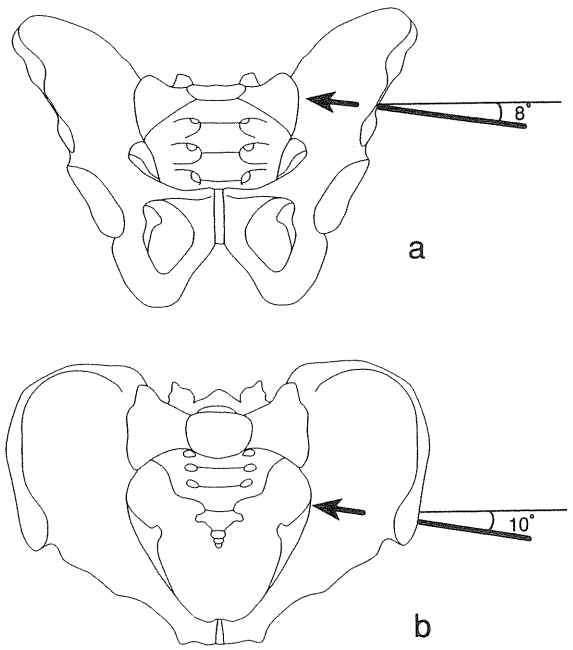


Figure 7. Diagram showing the direction of a spearhead shown in Figure 6. a; anterior view. b: superior view.

shaped blade, which is used in farming, may be a possible weapon.

Four bones were associated with metallic weapons or their remnants. From X-ray microanalysis, all of the metallic weapons were made of bronze. The distal portion of the humerus was associated with metallic a metallic weapon which was presumably spearhead. Figure 5 shows a split fracture of the humerus in which the trace of insertion by a spearhead is clearly visible.

Three hip bones were speared with bronze weapons. One was the ilium of juvenile of approximately 15-years-old, and the others were adult male coxae. In particular, a hip bone pieced by a bronze spearhead shown in Figure 6 is an important case. This is the first case indicating that spearheads were actually used in the war in Yayoi period. The spearhead was inserted almost horizontally from lateral side (Figure 7). The size of the spearhead is 35mm long and 8mm wide. In this specimen, another kind of bone injury was observed at the back. It is a clear-cut wound made by sharp metallic blade. That is, two kinds of wound were noted in one hip bone. It is speculated that the spearhead was first inserted to stop the motion of a victim, then sacrificed by a blade near the victim to make complete death.

In all bones with bone injury, there was no sign of healing along the injury lines except for one case, indicating that most of the victims were instantly killed.

The injuries were found in the bone of both sexes including juveniles. It is not clear from the bones with injury alone whether these bones showed the evidence of wholesale murder or not.

Unusual traces of bone injuries, which could not be interpreted as usual injury through the skin by weapons, were found in several bones. For example, a large part of a skull was cut as if the skull was planed off the corner. In other case, the tarsus was cut in half. Judging from the situation of bone arrangement in the excavation, it is apparent that the bones were not retained their original position. They were either carried by a water stream or were disturbed artificially. Since no lamination was observed in the stratum of surrounding soil, it is probable that these bones were disturbed by later grave-diggers.

The total number of the bones with injuries excavated from this site is more than that reported in all Japan of Yayoi period. This can testify many slaughter have caused here in the latter half of the second century. From history books of China, Japan (Wakoku) in that time was divided to many small countries and the wars were caused again and again. In the end, by these bones perhaps we can testify a great disturbance known as the "Wakoku Tairan".

Stab and Cut Wounds Found on Human Skeletal Remains from the Shibu Yayoi Site in Nara Prefecture, Japan.

Yumiko Oyabu[1] and Kazumichi Katayama[1]

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This paper describes very probably perimortem- induced sword injuries on ancient human skeletal remains from the Yayoi period, based on a close microscopic analysis.

It was in 1997 that a couple of human skeletons were dug up at the Shibu site in Kashihara-city, Nara prefecture, by an archaeological excavation which was carried out by Nara National Cultural Properties Research Institute. The site is famous as a huge settlement ground which developed in the middle Yayoi period (ca.2000 BP). The Yayoi period is critical as a turning point in Japanese history, because the population increased drastically and as a result, war-like conflicts between clan groups seemed to have become increased especially in the western Japan. As to the excavation and the site, see Fukasawa et al. (1998).

It should be noted that both the skeletons were buried in a very strange way. They were found in a rather small earth burial pit in an articulated supine position, with their bodies arranged side-by-side and with the heads toward an opposite direction (Plate 1). There is no indication to show that both the skeletons were buried at different times, but all the circumstances suggest that they passed away definitely at the same time, and that they were inhumed there very possibly just after the death.

A special mention should be made on a stone arrow, which was found inside the chest frame of rib bones in one skeleton (Plate 2), and on seemingly cut wounds in the other skeleton. Circumstantial evidence *in situ* shows that the stone arrow and the wounds were accompanied on the skeletons at the time when both the persons were killed. Burial offering was not found at all with both the skeletons.

As to both the skeletons, a preliminarily report has been published already by Katayama and Sugihara (1998), in which a brief information on their personal identification is presented.

It was found that one of the skeletons was of an adult male, and the other of a young adult female. The male person was estimated his age at death at 25 to 30 years old, and his living height at about 165 cm. With the female person, her age at death was estimated at 18 to 25 years old, and the living statue at about 156 cm.

The preservation state of bone elements was that in the male skeleton, nearly the whole bones remained well, but the skull, ribs, vertebrae and the hand and foot bones were very fragile or quite badly broken. In the female skeleton, almost all the bones were not well preserved and many of them became fragmentary, while every element remained.

RESULTS

Several bone wounds were found out through microscopic analysis both on the male and female skeletons.

The wounds discovered on both the skeletons are as follows: On the male skeleton, there were a total of five lesions, that is, on the lateral part of the right supra-orbital area on the frontal bone, on the lateral border of the left scapula, beside the antero-inferior iliac spine portion on the left hipbone, on the upper part of the greater sciatic notch of the left hipbone and on the upper part of the

greater sciatic notch of the right hipbone; on the female skeleton, several straight cut-like marks were found on the anterior surface of upper shaft on the left femur.

First, wounds on the male skeleton are described. The wound of the supra-orbital area (Plate 3A, 3B) was considered as a cut-off caused by somewhat sharp-edged weapon. It must have been made from superior to inferior. The size is 10 mm long and 28 mm wide. The cut plane is flat and a bit smooth on the upper half. There is no callus formation found around the lesion, so that it should have been cut perimortem. The scapula wound (Plate 4) is located about 23 mm below the glenoid fossa on the lateral border. The size is about 10 mm long, and the direction seems antero-posterior. The depth is 2 mm at the posterior portion and 0.5 mm at the anterior portion, and the width 1 mm or under. There is no healing reform found on the wound, so that this wound should also have been made at the death or just after the death. The cut edge is sharp. It seems to have been made from the upper direction with something sharp-edged.

With the two wounds on the lateral surface of left hip bone; one of them is located 20 mm behind the antero-inferior iliac spine and 13 mm above the upper margin of acetabular fossa (Plate 5A, 5B), the other is located 38 mm above the greater sciatic notch. The former is about 15 mm in length and about 2 mm in depth. The latter is about 20mm in length, and 1mm in depth. Both the wounds look rather shallow and very sharp in appearance, and there are many tiny fractures along the margins, so that they have been diagnosed to be stabs by a kind of weapon with very sharp points. There is no callus formation found at all with these lesions. Therefore, these wound should have been caused perimortem.

The wound on the right hip bone (Plate 6A, 6B) is located 25 mm above the deepest part of the greater sciatic notch. The lesion is quite short at about 10 mm long and about 1.5 mm wide. The edge is sharp and a bit concave partially due to minor fractures. Thus this wound can also be diagnosed to be a stab by a sharp-pointed tool. The external shape looks elliptic, probably reflecting the cross-section of the stab tool, as suggested in a similar case by Suzuki (1938). There is no evidence of showing any heeling, and thus this wound is also considered as having been produced at the death or just after the death.

Next, the wounds on the female skeleton are described. They look straight scratches arranged parallel, on the anterior surface of upper shaft of the left femur (Plate 7A, 7B). The direction is transversely medial to lateral, and the length varies at about 7 to 20 mm. All the wounds are very shallow around 0.5 mm deep. The edges of wounds are sharp in appearance, and show no heeling change. Thus these wounds should have been caused at the death or just after the death. With rib bones around the stone arrow imbedded, we cannot confirm any wound which should have been made at the time when it passed into her chest, because the rib fragments are so fragile.

DISCUSSION and CONCLUSION

As described above, a total of five

wounds have been ascertained on the male skeleton, and possible wounds have been found on the female skeleton as well. These have all been considered very likely as caused by injuries at the time of their death or just after the death.

It seems that there are several kinds of injuries. The wounds both on the supra-orbital margin of the frontal bone and on the left scapula in the male skeleton, have been caused by a cut using the very sharp-edged weapon. The three pelvic wounds on the male skeleton have very probably been stab injuries or thrusts by a sharp-pointed weapon. As to the scratch-like wounds on the left femur of the female skeleton, it is hard to assign any tool to make them.

Anyway, the microscopic analysis carried out in the present study, suggests that all the wounds on both the skeletons were produced by something like war-weapons of quite sophisticated type.

Because there is no callus formation found on every wound, it is no doubt that all the wounds were produced perimortem. That means both the persons were killed at the time when these wounds were printed on the bones. Especially, the cut wound of the frontal bone on the male skeleton must have been lethal.

On the female skeleton, there have been found any wound to be lethal. The stone arrow which was found inside the chest portion, should be enough evidence to suggest that she has also been the victim of some homicide case.

In conclusion, it is very probable that both the male and female skeletons were the bodies of victims, who were involved in some murder case. The situation of their burial indicates that they were earth-buried *in situ* soon after being killed using weapons. These skeletal remains provide a very interesting case to think about the happenings and weapons in the Yayoi period in Japan. A further investigation will be need into the actual weapons used.

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Plate 1. Photograph of the human skeletons unearthed at Shibu Yayoi site; Right, the male, left, female skeleton. (Taken by Nara National Cultural Properties Research Institute.)

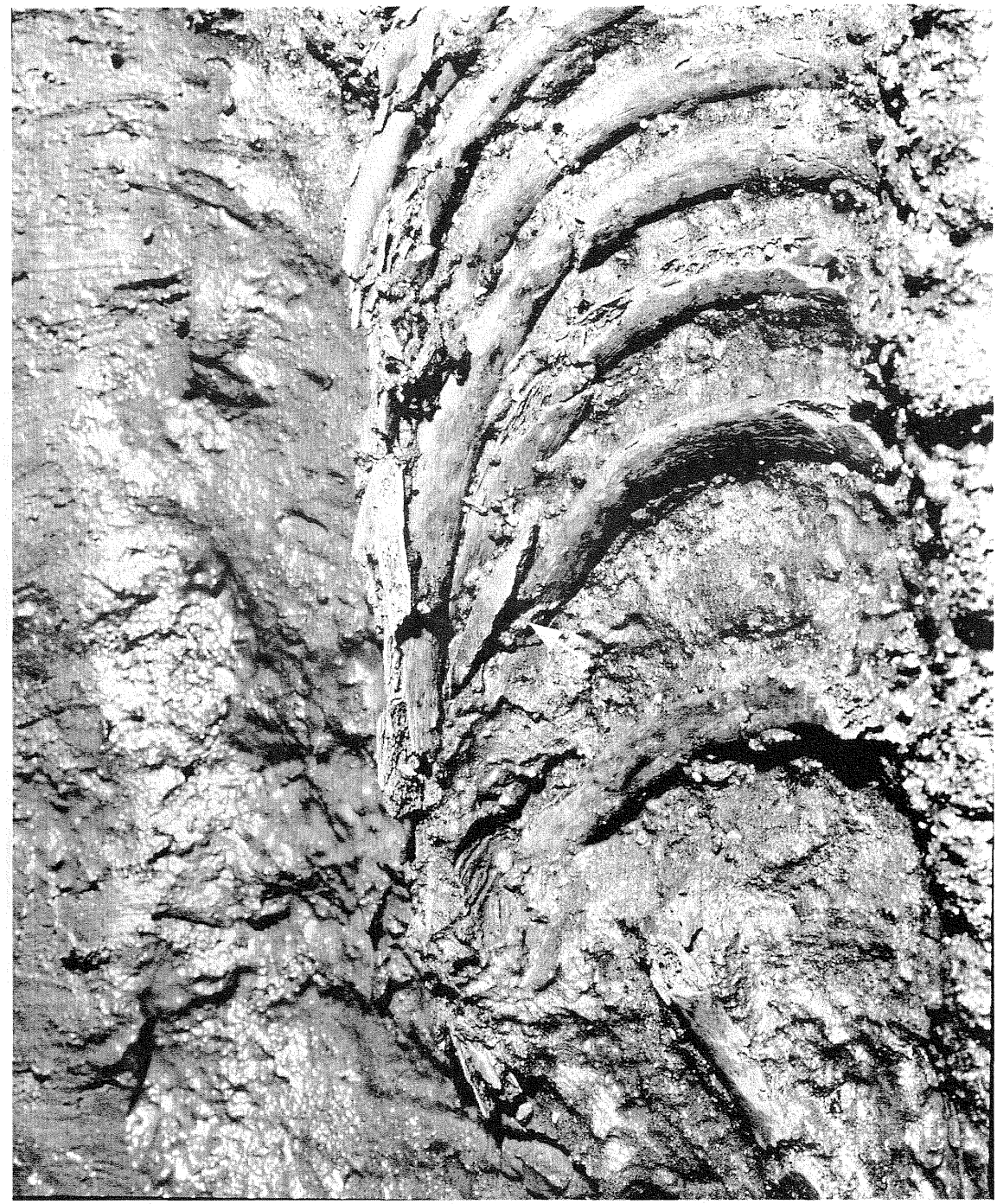


Plate 2. Photograph of the right chest portion of the female skeleton. A stone arrow is pointed. (Taken by Nara National Cultural Properties Research Institute.)

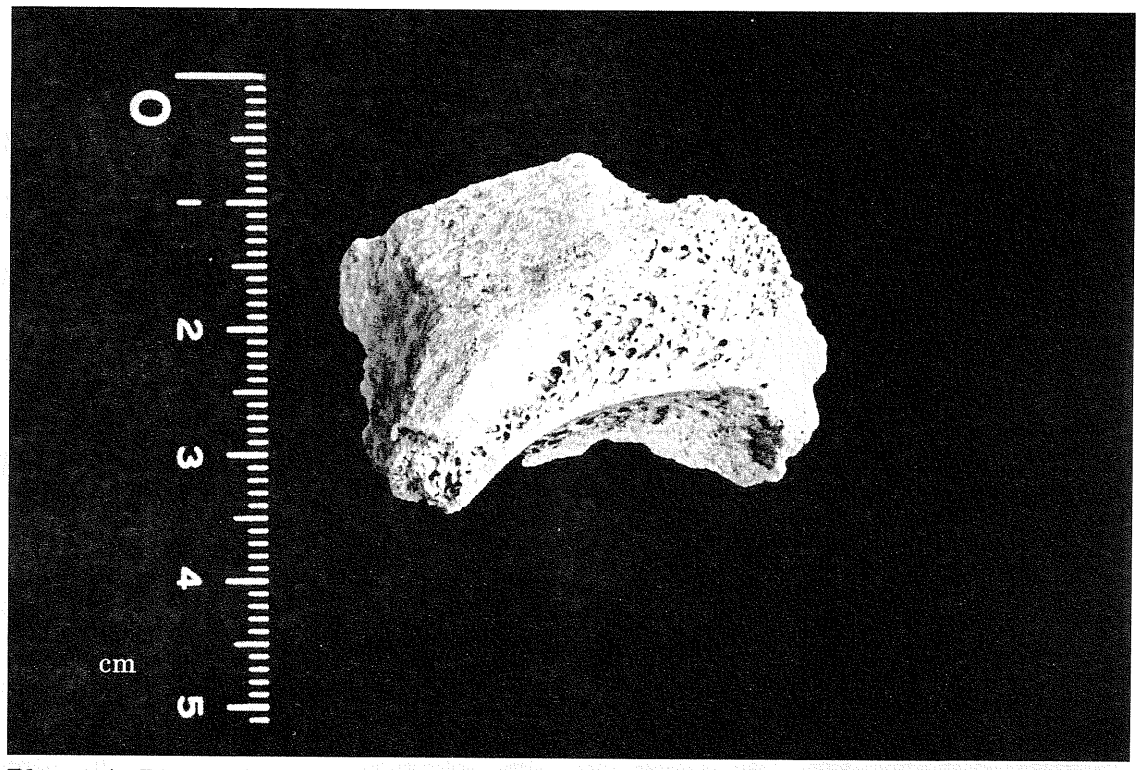


Plate 3A. Photograph of the lateral part of the supra-orbital frontal bone on the male skeleton.

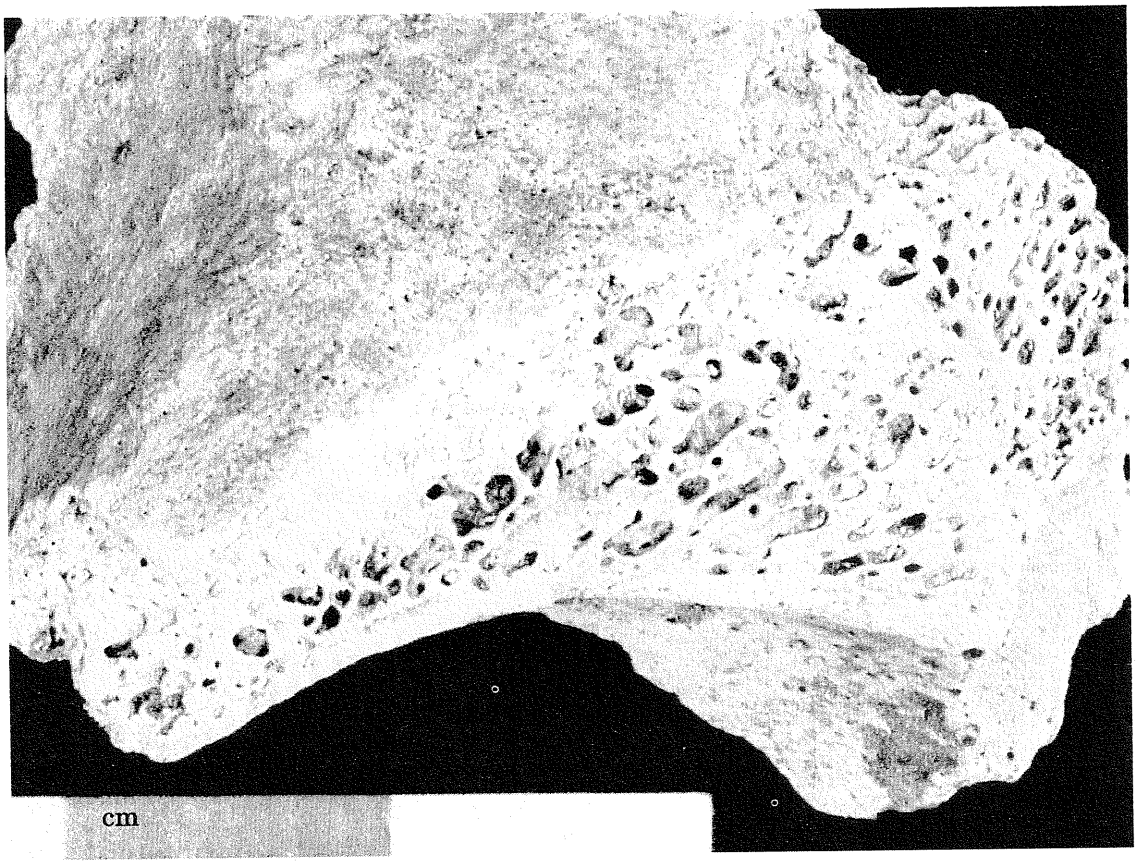


Plate 3B. Close-up photograph of the wound in Plate 3A.

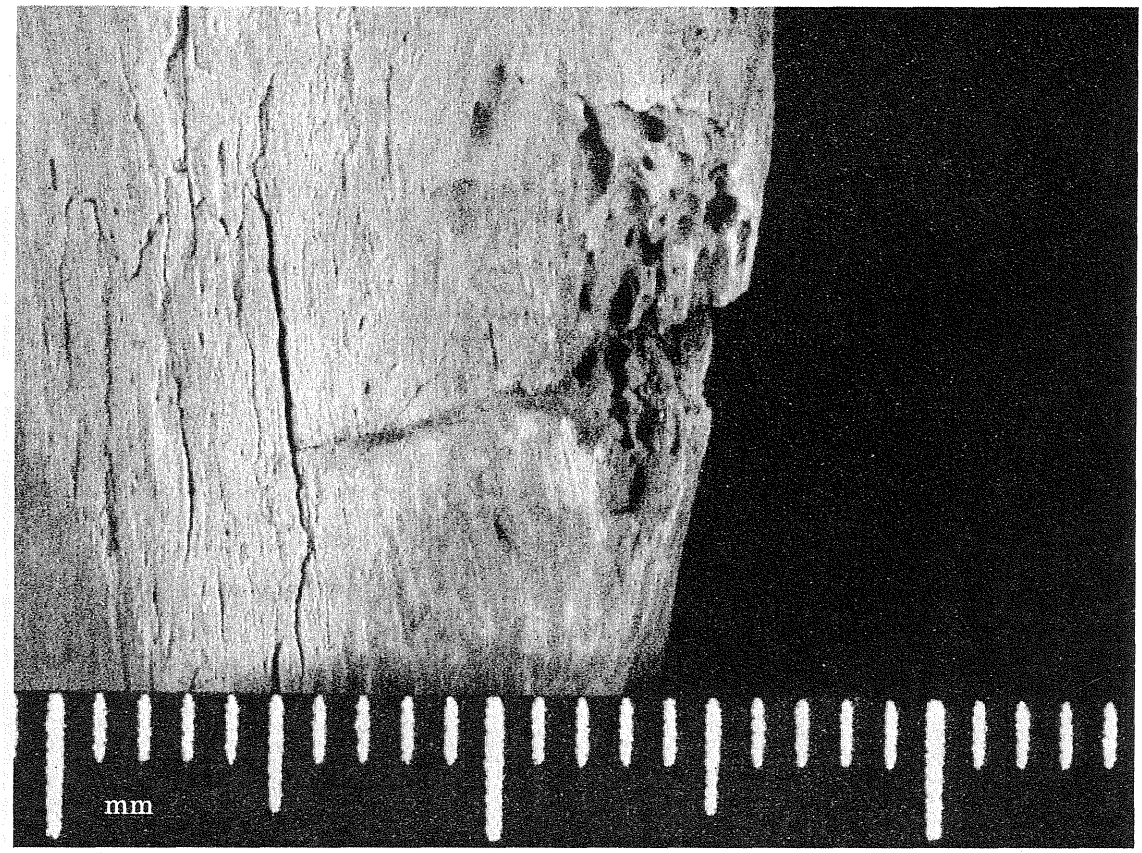


Plate 4. Close-up anterior view of the wound on lateral border of the left scapula on the male skeleton.

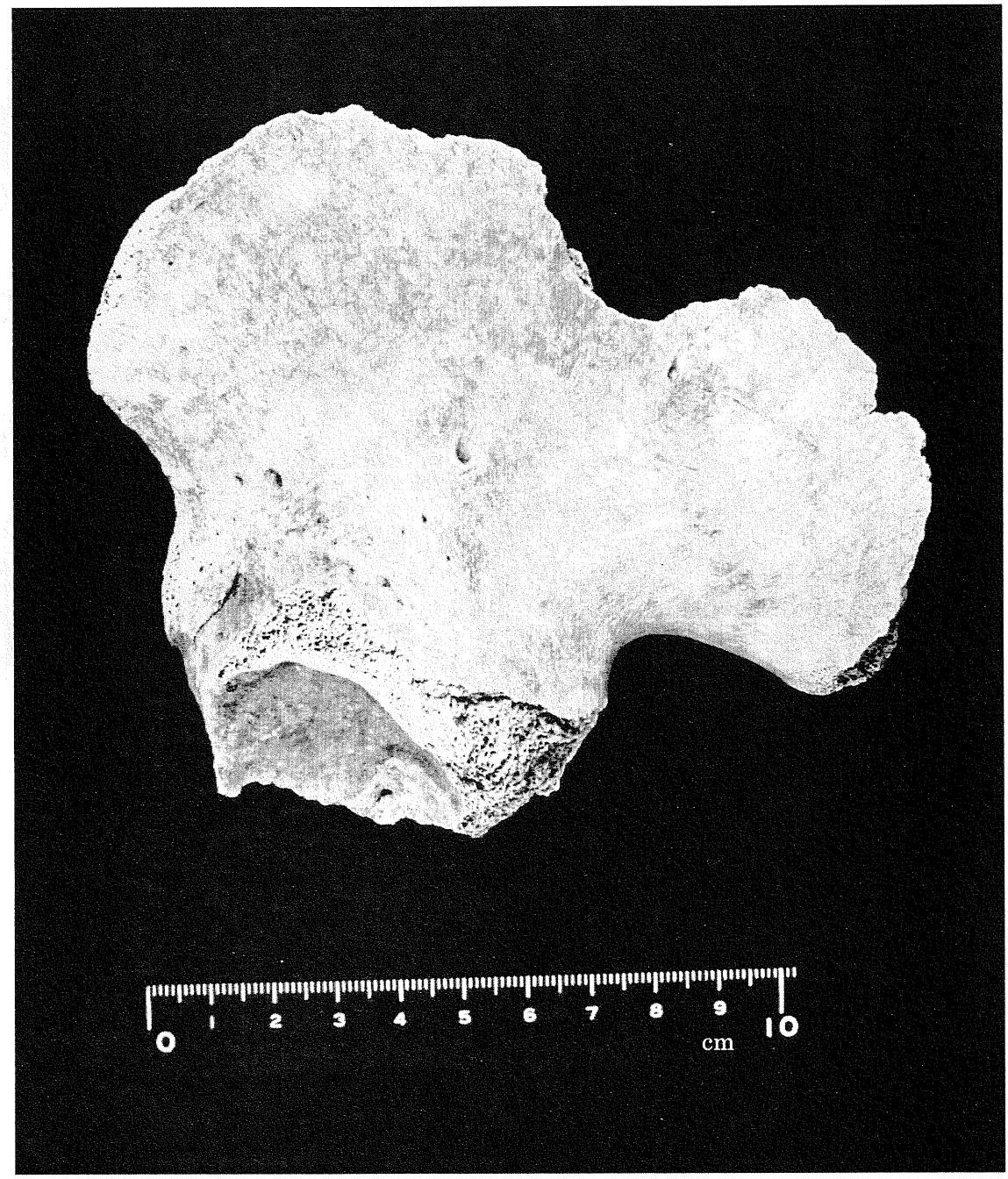


Plate 5A. Lateral view of the left pelvic bone on the male skeleton.

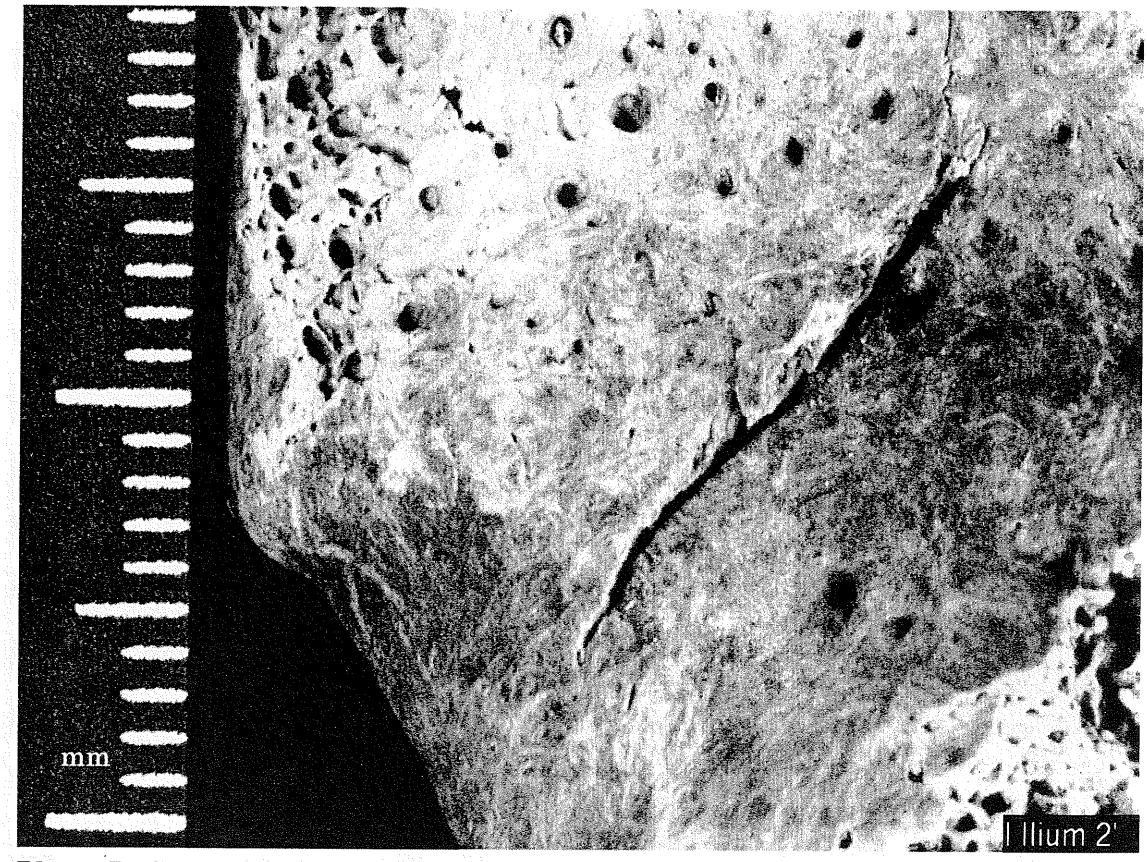


Plate 5B. Close-up view of the wound on the antero-inferior iliac spine portion.

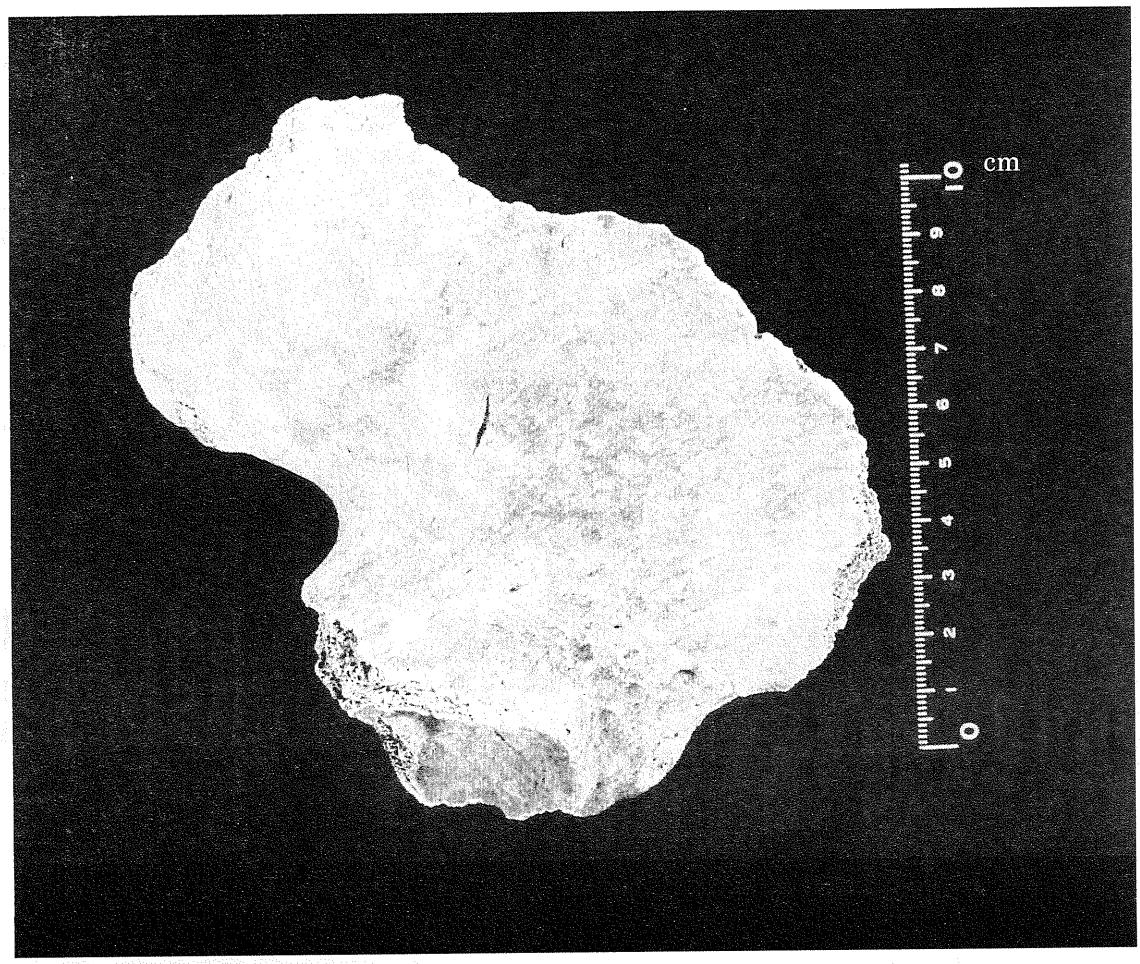


Plate 6A. Lateral view of the right pelvic bone.

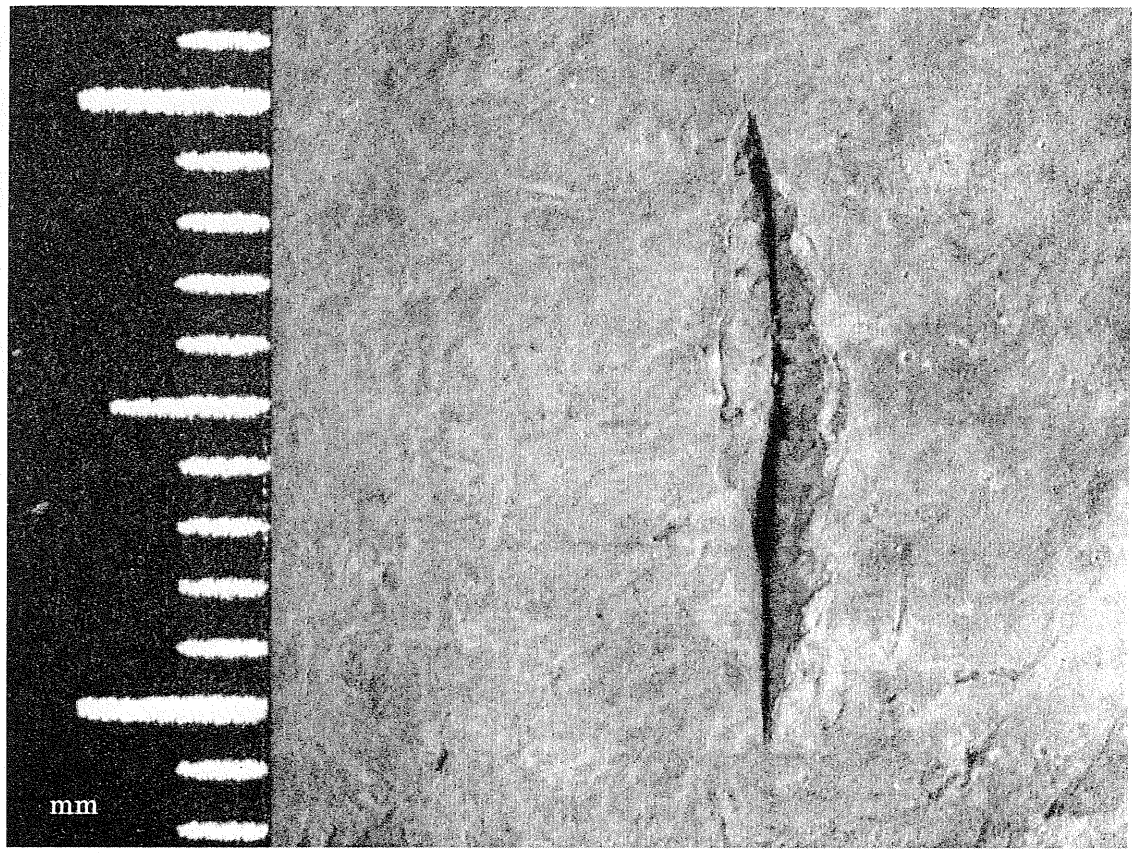


Plate 6B. Close-up photograph of the wound on the right.

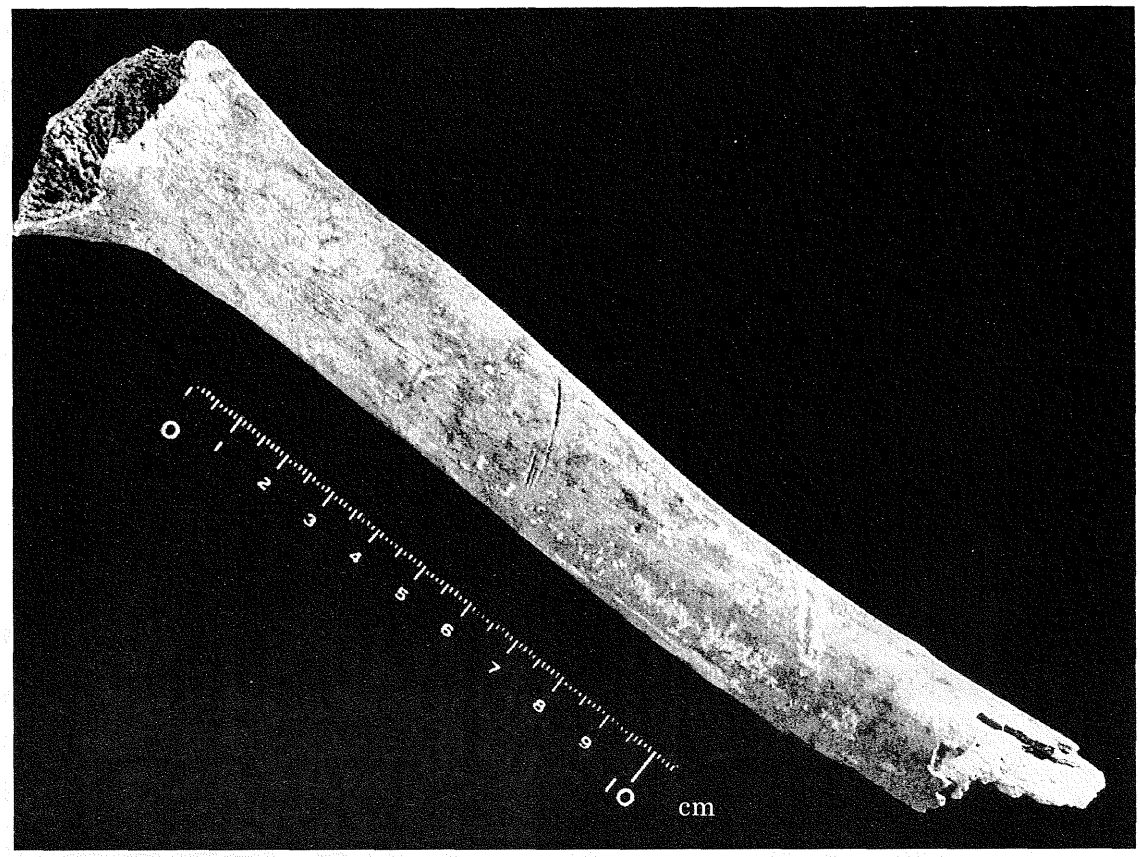


Plate 7A. Anterior view of the left femur shaft on the female skeleton.

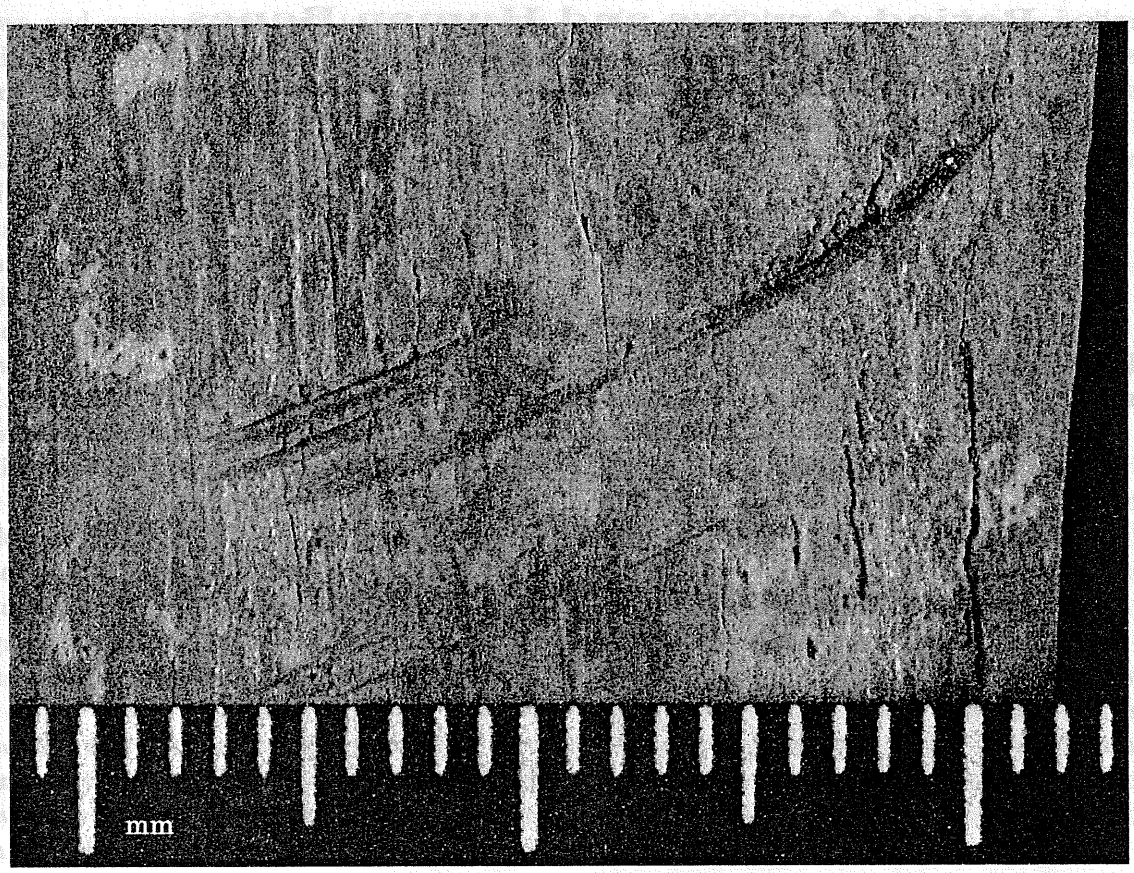
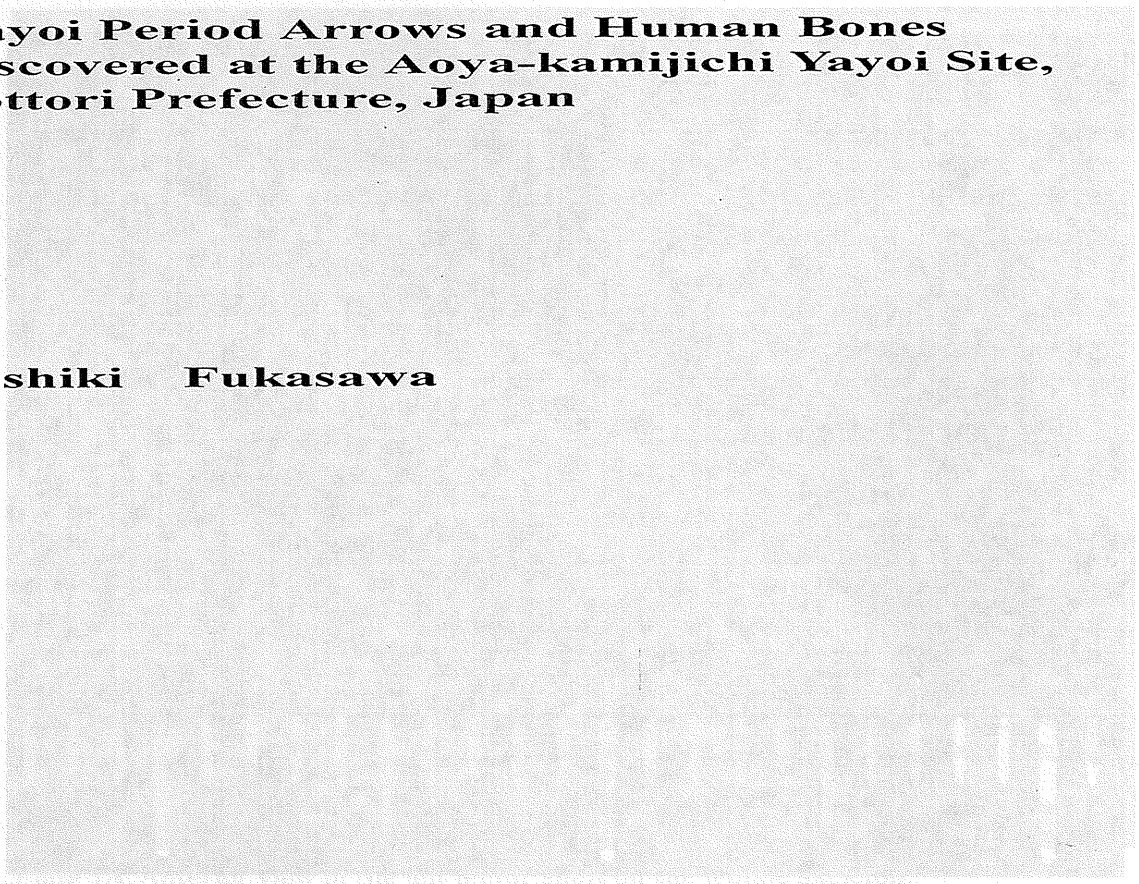


Plate 7B. Close-up photograph of the wound on the femur.

Yayoi Period Arrows and Human Bones Discovered at the Aoya-kamijichi Yayoi Site, Tottori Prefecture, Japan

Yoshiki Fukasawa



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Introduction

Bows and arrows remained to be important shooting tools (weapons) during the Yayoi Period of protohistoric Japan. Arrows were shot owing to the strong resiliency of elastic bows. Ritual bronze bells or dotaku depict that the Yayoi period hunters used bows and arrows against deer and wild boars. Further, the archaeological discoveries of human skeletal remains at the Takashi-Jinja site, Saga Prefecture (jar burial SJ018), in which arrowheads were imbedded into bones, and at the Katsube site, Osaka Prefecture (No. 2 burial), in which several arrowheads were found associated with bones, definitely indicate that bows and arrows were intentionally used against people too.

The Aoya-kamijichi site is one of the Yayoi period archaeological sites where archaeologists can gain insight into the use of bows and arrows against people. It is a settlement site located in the Aoya town, Kedaka County, Tottori Prefecture, and archaeological excavations have continuously been carried out since 1998. Excavations in 2000 unearthed a great number of human skeletal remains at the western bank of a ditch eight meters wide and 0.8 meters deep, which demarcated the eastside of the settlement. Some of the human bones discovered there, showed evidence of being affected heavy injuries.

Those human bones were dated to the later half of the late Yayoi Period (ca. the 2nd century AD), and this was the first example to be found in the dated of the 2nd century AD. Professor Inoue conducted detailed examination of all the skeletal remains. Among the human bones with injuries, three bones retained fragments of bronze weapons with them. One of them was found out to be a tip of bronze arrowhead. The size and shape of the injuries suggested that the other two must have been bronze arrowheads too. With this discovery, Japanese archaeologists have finally been able to confirm that bronze arrowheads were used against humans in the Yayoi Period. In addition, discoveries of a skull and a rib bone with oval holes lead me to speculate that bone arrowheads were also used against them. The size and shape of the bone arrowheads discovered at this site, are very similar in cross-section to those of the bone injuries.

While those discoveries at the Aoya-kamijichi site are all important, we have not discovered any arrow there because of the materials for the shafts. Therefore, I attempt to speculate about what kind of arrows was used at Aoya-Kamijichi and other places during the Yayoi Period in Japan.

Arrow Discovered at the Kitoragawa Site, Osaka Prefecture

This arrow was in an unusually good preservation. It was discovered during the 29th excavation in ditch SD22, dated to the first half of the middle Yayoi Period (Phases II and III, ca. the 2nd and first centuries BC). At the time of the discovery, the length of the stone arrowhead was 99.0 centimeters from the tip to the bottom of nock. The stone arrowhead was 3.85 centimeters in length, 2.15 centimeters in width, and 0.45 centimeters in thickness, and it was triangular with two projecting feet (without tang) in morphology. The tip was slightly broken, suggesting that this arrow was actually used. The raw material stone of the arrowhead was Sanukite, a basalt-like rock. The arrowhead was attached to the tip of the foreshaft. While tree bark was not used for tying the arrowhead to the shaft, white substance was attached near the base of the arrowhead and the tip of the foreshaft. The white substance probably functioned as glue. Although the tip of the foreshaft was lost, I speculate that the tip was originally divided into two, so that these two could clamp the arrowhead. I have tried to reconstruct that the foreshaft was 18.1 centimeters in length, 2.9 centimeters in the length of the "clamp" portion, 13.2 centimeters in the length of the main portion, 0.8 centimeters in the diameter, and 2.0 centimeters in the length of base.

The base portion was then further inserted into the top of the main shaft. Mr. SHIMOMURA Harufumi speculates that the main shaft was made from the wood a young oak tree, but I can not deny the possibility that it was made of bamboo. The diameter was approximately 0.9 centimeters. The length of the mains halft at the time of discovery was 82.0 centimeters, and I suspect that it was originally 83.0 centimeter long or so. If the main shaft was indeed wooden, then it should be necessary

to drill a hole at the top of the main shaft, so that the foreshaft could be inserted. A tree bark was wrapped over the top 4.0-centimeter-portion of the main shaft. This wrapping was probably necessary to absorb the shock at the time of impact, so that the joint between the foreshaft and main shaft would not be damaged so much. On the shaftment butt, a tree bark was wrapped at the points of 79.6 centimeters and 96.8 centimeters from the arrowhead. The former wrapping covered the 4.0-centimeter portion of shaftment butt, and the latter 2.2 centimeters. I agree with Mr. Shimomura that fletching was attached at these points. Although a nock was lost, the way in which a tree bark was wrapped the shaftment butt, suggests that the bottom only of one to two centimeters was lost from the shaftment butt.

Arrows of the Yayoi Period

Referring to other fragmentary discoveries of arrows, I attempt to reconstruct the morphology of the Yayoi Period arrows. I particularly look into the following attributes: the length, arrowhead, a way in which an arrowhead was adopted to the shaft, foreshaft, main shaft, fletching, and nock. For reconstruction experiments, I have used a tree bark to tie different parts of an arrow.

<Length>

The Kitoragawa discovery is the only one example that allows us make a fairly accurate reconstruction of the entire length of an arrow during the Yayoi Period and even those of the preceding Jomon Period. Therefore, it should be examined whether the length of the Kitoragawa arrow represents the typical one or not.

Typical arrows of the Kofun and early Historic Periods were between 70 and 85 centimeters in length, most gathering around 80 centimeters. In comparison to this, the Kitoragawa example of nearly 100 centimeters is unusually long. Nevertheless, if we remov the foreshaft and the top portion of the main shaft where the foreshaft was inserted (16.1-centimeter long in total), then the total remaining length would be 83 centimeters. This figure is within the range of the length of typical Kofun Period arrows. I consider it very important that the length of the main shaft of the Kitoragawa arrow is in a range within the mean length of the Kofun Period arrows. It seems difficult to consider this as mere coincidence, because the length of ethnographic examples of arrows greatly varies from 46 to 145 centimeters. I therefore argue that the typical length of the Yayoi Period arrow was around 83.9 centimeters.

If this is indeed the case, the Kitoragawa arrow should be considered as the one putting a foreshaft to a typical arrow. My view is in agreement with Mr. IMOMOTO Takahiro who speculates that the foreshaft of a Yayoi Period arrow was kept ahead of a bow when shooting the arrow. Since a tree bark was wrapped very thick at the joint of the foreshaft and main shaft, this thick layer of tree bark would have prevented an arrow from leaving the bowstring.

<Arrowhead>

An arrowhead plays an important role; it not only determines the point of balance for the arrow, but it also adjusts the degree of damage the arrow causes to a target. People of the Yayoi Period adopted a wide variety of raw materials for their arrowheads, including stone, tooth, antler, bone, wood, bronze and iron. During the Yayoi period, the stone came to be replaced with the iron. In addition, I suspect that bamboo was utilized during the Yayoi Period, although no archaeological evidence has been reported yet. My suspicion is based on the presence of arrows with bamboo-made arrowheads in the Shoso-in treasury of Todai-ji temple (Historic Period) and on the practice of the Ainu people hunting with bamboo arrowheads.

< Way in which an arrowhead was adopted to the shaft>

When an arrowhead is made as a part separate and independent from the shaft, the arrowhead must somehow be attached to the foreshaft or main shaft at its pile. We currently know the following four methods: I) to create a groove into which an arrowhead is inserted; II) to insert the tanged portion at the base of an arrowhead into a hole at the pile; III) to insert the pile into a hole drilled into the base of an arrowhead; and IV) to tie one face of an

arrowhead onto the shaft. Among these four, we have direct archaeological evidence for the methods I and II. At the Aoya-kamijichi site, archaeologists discovered a bone arrowhead, on which a hole was drilled into the basal portion of the arrowhead. This suggests the adoption of the method III. I also consider that there was possibly the method IV, because it is the way in which a spear head is tied to the shaft.

Once an arrowhead is joined to the shaft of an arrow, it is then necessary to make solid the joint. During the Yayoi Period, the joint was either tied solidly with a tree bark or not tied at all. Both the methods were present at the Kitoragawa site, and the dates for the both were more or less the same. This suggests to me that people during the Yayoi Period paid great attention to varying strength with which an arrowhead was tied to the shaft of an arrow.

The purpose of tying the joint is to keep an arrowhead from detaching from the shaft and to keep the shaft from damaging due to the impact of shooting a target. The arrow craftsman at the Kitoragawa settlement was fully aware how this impact influenced on an arrow. This is evident because a tree bark was used more for wrapping and tying the main shaft than foreshaft at their joint.

Then, what would be the purpose of not tying the joint of an arrowhead with the shat? This would make it easy that the arrowhead detaches from the shaft. In this context, New Guinea's Dani's use of arrows is insightful. The Dani people distinguish arrows for battle from those for hunting. The former is featured by weak joint between the foreshaft and main shaft. When an arrow penetrates into a body, the foreshaft easily detaches from the main shaft and remains in the body, so that it keeps causing pain to the victim. It is therefore possible to assume that the joint between the foreshaft and main shaft is not tied and wrapped for the same purpose as Dani's case. This purpose supercedes the structural deficiency of the weak joint.

<Foreshaft>

A foreshaft is a part between an arrowhead and the main shaft of an arrow. Foreshafts in the Yayoi period were made from wood and antler. Their archaeological discoveries are widely reported from the western Japan. Generally, foreshafts should be solid pieces, and consequently bamboo is not adopted as the material. In Japan, however, archaeological evidence exists that arrowheads were attached to bamboo shafts. This indicates that foreshafts were not always adopted during the Yayoi period.

A foreshaft consists of the following three parts: the "clamp" part where an arrowhead is placed, neck part, and shaft part to be inserted into the main shaft. In the Yayoi period, two types of neck parts were adopted: one the cylindrical neck and the other the conical neck. In some foreshafts no "steps" exist at the border of the neck part and shaft part, while in others steps do exist. During the Yayoi period, the majority of the foreshafts had the cylindrical neck with steps at the border. Rather unusual foreshafts have been discovered at the Sasai site, Fukuoka Prefecture and Araominami site, Gifu Prefecture. In these examples, necks were conical with a step in the former and no step in the latter.

Foreshafts in Japan was first adopted in the late Jomon period (ca. 1,000 BC), but these should be distinguished from the Yayoi period foreshafts. While deer antler was utilized for the Jomon foreshafts, the Yayoi foreshafts were primarily wooden. The cross-sectional morphologies of neck parts were distinctive. In the Jomon foreshafts, the necks were conical, and the cross-section was like a double convex lens. In the Yayoi foreshafts, the necks were either cylindrical or conical. In the conical case, the cross-section was like a double concave lens. In the late Jomon period no foreshaft exceded the length of 10 centimeters. It was the Yayoi period foreshafts that evolved into those in the Kofun period and early historic period foreshafts. An example of the Kofun period foreshafts has been discovered at the Nanamawari-Kagamizuka site in Gunma Prefecture (the late Kofun period, the sixth ceentury AD), and some early historic foreshafts are still preserved in the Shosho-in Tresury.

<Mainshaft>

A foreshaft was inserted into a main shaft. In order to do so, it is necessary to drill a hole into the top of the main shaft or the main shaft

must be hollow. Ethnography of the Ishi native-Americans in California, North America, shows that such drilling was a simple work. The same was probably the case for the Yayoi period. Both the solid wood and bamboo were adopted as the material of main shafts. Spatial and temporal distributions of these two cases overlap considerably. Examples of solid wood have been reported from the Hie site in Fukuoka Prefecture, Kitoragawa site in Osaka Prefecture (findings in the seventh and 29th excavations), and Yokaichijikata site in Ishikawa Prefecture. Bamboo mainshafts have been discovered at the Yuno site in Fukuoka Prefecture, Mekumi site in Tottori Prefecture, Kamei site in Osaka Prefecture, and Nakazaike site in Miyagi Prefecture. It is likely that both solid wood and bamboo main shafts were adopted. This was the case for the late Jomon period, as well as in the data of ethnographic Ainu.

<Fletching>

No archaeological discovery of fleching has been reported in the Yayoi period. Nevertheless, some of ritual bronze bells and the Yayoi pottery depict arrows with fletching. Therefore, it is highly likely that fletching was used for the Yayoi prieod arrow, although we are uncertain that this fletching procedure was for improving the trajectory. The Yayoi period fletching is depicted as two arcs along the main shaft. If this rendition is accurate, each fletching was semi-circular in plan, and two or more fletchings were adopted. As to the number of fletching for an arrow, we have no idea for the Jomon period (we are uncertain if fletching was adopted). For the succeeding Kofun period, discoveries of arrows with two fletchings have been reported at the following early-phase sites (the late third to fourth century AD): the Kambara Jinja tumulus in Shimane Prefecture, the Mesuriyama tumulus in Nara Prefecture, and the Yukinoyama tumulus in Shiga Prefecture. Arrows with two, three and four fletchings have been discovered at the middle phase (the fifth century AD) Doboyama Tumulus. Finally arrows with two fletchings have been discovered at the Nanamawari-Kagamizuka tumulus (the late phase, sixth century AD). Arrows in the Shoso-in Tresury have two, three or four fletchings. These discoveries suggest that arrows had two fletchings at the beginning of the Kofun period, and the number of fletching increased as time passed. Consequently, it is possible to assume that the number of fletching during the preceding Yayoi period was two. Referring to the Kitoraagawa example, the length of flething is likely to be 13.2 centimeters.

<Nock>

A nock is at the end of an arrow, and is a part where bowstring is placed. Thus far, only one discovery of nock dated to the Yayoi Period has been reported. The discovery took place at the Yokaichijikata site, Ishikawa Prefecture. A groove was set at the end of the Yokaichijikata arrow, and tree bark was wrapped over the portion immediately in front of the groove. This tree bark was probably to strengthen the main shaft and to securing the fletchings.

Conclusion

This paper has presented a hypothetical reconstruction of a typical arrow used during the Yayoi Period. If the reconstruction here presented is indeed the case, it is likely that this type of arrows were used against victims which are represented by the human skeletal remains discovered at the Aoya-kamijichi site.

Weapons in Yayoi Period

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Abstract of Paper

It happened that weapons were brought into the Japanese archipelago from the Korean peninsula firstly at the beginning of the Yayoi period (approximately 4-5th century BC). In those weapons, were stone daggers and arrowheads, which were made using a highly developed grinding technique. During the 3rd-2nd century BC, further bronze weapons were introduced again from Korea. They can be divided into three types; daggers, lances and *ka* (hammer-like lances), which were used in close fights together with stone weapons. Arrowheads began to be made of iron around that time especially in the Kyushu district, the western Japan.

From AD the 1st to early 3rd century, during the latter half of the Yayoi period, iron weapons became more and more popular not only within Kyushu but in other central parts of the archipelago. Daggers, swords, lances and arrowheads were main iron weapons from this time to the former half of the Kofun era (from AD the late 3rd century to 5th century). Arrowheads made of wood, antler or bone seem to have increased around this time. On the other hand, bronze weapons except arrowheads, most of which appeared in this time, became much larger in size as ritual goods out of use in real fights, and stone weapons gradually decreased to perish within AD the third century.

In the Kofun era, especially AD the 4th century onward, iron weapons only survived as substantial weapons. Their types also limited to daggers, swords, and arrowheads, although the other iron armours and a kind of lance from Korea appeared changed those mainly as grave goods. By the Kodai era (the so-called Archaic *Ritsuryo* state period, AD the 7th-8th century), iron swords and arrowheads occupied the position of cardinal weapons at warfare. Nearly the same situation continued later, we can observe it throughout medieval ages.

In this way, the weapons in the Yayoi became more diversified in their kinds and forms, and were made of more various materials than those in any other age in the Japanese history. Firstly, it is because that an already-established set of weapons for complicated war styles and military systems, which developed in the continent, was brought into Japan by immigrants directly from the Korean peninsula. Secondly, in the archipelago, when these weapons were produced or imitated, they used various materials such as stone, bronze and later iron, because this period saw considerably rapid transition from stone to metal as the main material resource.

It is very possibly a reason for that there are more various forms in injuries or cut marks in the outlines on human skeletal remains in this period than those in the other ages as in the medieval Kamakura period, when the types and materials of weapons were less diverse.

References

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